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10/662,969	09/15/2003	Trevor MacDougall	WEAT/0414	1106

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EXAMINER	
LIU, LI	
ART UNIT	**PAPER NUMBER**
2613	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/14/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/662,969	Applicant(s) MACDOUGALL ET AL.
	Examiner Li Liu	Art Unit 2613

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 16 January 2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1,2,4-12,14,16-22 and 25-27 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,2,4-12,14,16-22 and 25-27 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 15 September 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 1, 3-6, 11, 13-14, 21 and 23 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 4-6, 8-11, 14, 18-21 and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davis (US 6,346,702) in view of Cooper et al (US 2002/0025097) and Wang et al (Wang et al: "Analysis and Suppression of Continuous Periodic Interference for On-Line PD Monitoring of Power Transformers", High Voltage Engineering Symposium, 22-27 August 1999, 5.212.P5).

1). With regard to claims 1, 4-6 and 25, Davis discloses an optical system (Figure 2B) comprising:

a source (BROADBAND SOURCE 12 in Figure 2B) for producing optical signals;

an optical waveguide (Form the coupler 14 to FBG 18 in Figure 2B) having a noise producing element (connectors, splicers or imperfections in the FBG itself, column 1 line 40-41) and an optical filter element (the FBG 16 or 18 in Figure 2B);

a receiver for (20 in Figure 2B) converting applied optical signals into electrical signals;

a coupler (14 in Figure 2B) for coupling said produced optical signals into said optical waveguide and for coupling reflections from said noise producing element and from said optical filter element to said receiver (20 in Figure 2B) as applied optical signals (column 3 line 59-64); and

a noise reduction system (the combination of 32 and 34 in Figure 2B) for removing noise produced by said noise producing element from said electrical signals (column 4 line 16-67).

Davis uses spectral analysis to analysis noise (32 and 34 in Figure 2B, and Figure 3 and 4). But Davis does not expressly disclose that (A) the noise reduction system performs a frequency analysis of the electrical signals to identify **periodic noise**; and (B) further removes the periodic noise from the electrical signals (claim 4); and (C) the periodic noise is removed by gating the periodic noise out of the electrical signals (claim 5); and (D) the frequency analysis is a Fourier analysis (claim 6); and (E) wherein the noise reduction system identifies periodic noise by identifying a rapidly varying signal from the frequency analysis (claim 25).

With regard to items (A)-(C), however, Cooper et al discloses a system in which the noise reduction system (20 in Figure 2 and 7) performs a frequency analysis (a standard optical spectrum analyzer, [0071]) of the received signals to identify and further removes the noise from the optical signals. Cooper et al uses the frequency analysis and gating method to obtain a specific frequency and remove unwanted other

frequency (Figure 4A – Figure 4C, [0071]). Although Cooper et al does not expressly state that the other frequency (e.g. the peak just on the left side of the 1553.4 nm in Figure 4A, which is shown in Figure 4C) is a "periodic noise", that peak is indeed a "noise" relative to the specific frequency component 1553.4 nm which is shown in Figure 4B; and since this "noise" is generated by another FBG, it is indeed a "periodic noise". Therefore, Cooper et al's system is fully capable to remove other periodic noise produced by connectors and splicers et al. And the wideband noise can be removed by gating the noise out of the electrical signals too (Figure 8, [0077]).

Cooper et al also discloses the noise reduction system performs a frequency analysis of the electrical signals and removes the periodic noise from the electrical signals by gating the periodic noise out of the electrical signals (Figure 13, page 8, [0091], "Each of these high-speed electrical pulses will now contain the wavelength information of their respective sensor grating 30A to 30N. These pulses are then passed to the electronic gating unit 142 where the pulses from the different sensors are isolated and measured for their wavelength information in a similar manner to the gating action performed on the optical signal in unit 20 except now performed electronically instead of optically. The signal from the reference detector is relayed to the electronic gating unit 142 through path 146 to serve as a timing reference").

To perform a frequency analysis, such as a Fourier analysis (item D), and identify periodic noise by identifying a rapidly varying signal from the frequency analysis (item E) on an electrical signal is well known and widely used method in the art. Wang et al discloses a system and method that uses Fast Fourier Transform technique to analyze

the periodic noise of an electrical signal and remove the periodic noise from the electrical signals (Abstract, Methods of Interference Eliminated) and the system identifies periodic noise by identifying a rapidly varying signal from the frequency analysis (Figures 2 and 3, and Digital Filtering Technique).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the frequency analysis and noise gating as taught by Cooper et al and Wang et al to the system of Davis so that the noise can be efficiently identified and removed or gated out of the electrical signals, and measurement accuracy can be enhanced.

2). With regard to claim 8, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 1 above. And Davis et al further discloses wherein the optical filter element includes a fiber Bragg grating (FBG 16 or 18 in Figure 1B).

3). With regard to claim 9, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 1 above. And Davis further discloses wherein the optical waveguide includes a discontinuity (connectors, splicers or imperfections in the FBG itself, column 1 line 40-41).

4). With regard to claim 10, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 1 above. And Davis further discloses wherein the discontinuity is a splice (splicers, column 1 line 40-41).

5). With regard to claims 11, 14 and 26, Davis discloses a sensor comprising:

a source for producing optical signals (BROADBAND SOURCE 12 in Figure 2B);

an optical waveguide (Form the coupler 14 to FBG 18 in Figure 2B) having a noise producing element (connectors, splicers or imperfections in the FBG itself, column 1 line 40-41) and an optical filter element (the FBG 16 or 18 in Figure 2B);

a receiver (20 in Figure 2B) for converting applied optical signals into amplified electrical signals;

a coupler (14 in Figure 2B) for coupling said produced optical signals into said optical waveguide and for coupling reflections from said optical waveguide as applied optical signals to said receiver (column 3 line 59-64); and

a signal processor (the combination of 32 and 34 in Figure 2B) for removing noise produced by said noise producing element from said electrical signals.

Davis uses spectral analysis to analysis noise (32 and 34 in Figure 2B, and Figure 3 and 4). But Davis does not expressly disclose that (A) the signal processor performs a frequency analysis of the electrical signals to identify and remove **periodic noise** from the electrical signal; and (B) the frequency analysis is a Fourier analysis (claim 14); and (C) wherein the signal processor identifies periodic noise by identifying a rapidly varying signal from the frequency analysis (claim 26).

With regard to items (A) and (B), however, Cooper et al discloses a system in which the noise reduction system (20 in Figure 2 and 7) performs a frequency analysis (a standard optical spectrum analyzer, [0071]) of the received signals to identify and further removes the noise from the optical signals. Cooper et al uses the frequency analysis and gating method to obtain a specific frequency and remove unwanted other frequency (Figure 4A – Figure 4C, [0071]). Although Cooper et al does not expressly

state that the other frequency (e.g. the peak just on the left side of the 1553.4 nm in Figure 4A, which is shown in Figure 4C) is a "periodic noise", that peak is indeed a "noise" relative to the specific frequency component 1553.4 nm which is shown in Figure 4B; and since this "noise" is generated by another FBG, it is indeed a "periodic noise". Therefore, Cooper et al's system is fully capable to remove other periodic noise produced by connectors and splicers et al. And the wideband noise can be removed by gating the noise out of the electrical signals too (Figure 8, [0077]).

Cooper et al also discloses the noise reduction system performs a frequency analysis of the electrical signals and removes the periodic noise from the electrical signals by gating the periodic noise out of the electrical signals (Figure 13, page 8, [0091], "Each of these high-speed electrical pulses will now contain the wavelength information of their respective sensor grating 30A to 30N. These pulses are then passed to the electronic gating unit 142 where the pulses from the different sensors are isolated and measured for their wavelength information in a similar manner to the gating action performed on the optical signal in unit 20 except now performed electronically instead of optically. The signal from the reference detector is relayed to the electronic gating unit 142 through path 146 to serve as a timing reference").

To perform a frequency analysis, such as a Fourier analysis (item B) and identify periodic noise by identifying a rapidly varying signal from the frequency analysis (item C) on an electrical signal is well known and widely used method in the art. Wang et al discloses a system and method that uses Fast Fourier Transform technique to analyze the periodic noise of an electrical signal and remove the periodic noise from the

electrical signals (Abstract, Methods of Interference Eliminated) and the signal processor identifies periodic noise by identifying a rapidly varying signal from the frequency analysis (Figures 2 and 3, and Digital Filtering Technique).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the frequency analysis and noise gating as taught by Cooper et al and Wang et al to the system of Davis so that the noise can be efficiently identified and removed or gated out of the electrical signals, and measurement accuracy can be enhanced.

6). With regard to claim 18, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 11 above. And Davis et al further discloses wherein the optical filter element includes a fiber Bragg grating (FBG 16 or 18 in Figure 1B).

7). With regard to claim 19, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 11 above. And Davis et al further discloses wherein the optical waveguide includes a discontinuity (connectors, splicers or imperfections in the FBG itself, column 1 line 40-41).

8). With regard to claim 20, Davis et al and Cooper et al and Wang et al disclose all of the subject matter as applied to claim 1 above. And Davis et al further discloses wherein the discontinuity is a splice (splicers, column 1 line 40-41).

9). With regard to claims 21 and 27, Davis discloses a method of compensating for optical reflection comprising:

producing an optical signal (BROADBAND SOURCE 12 in Figure 2B);

coupling (14 in Figure 2B) the optical signal into an optical waveguide having a noise producing element and an optical filter element;

converting (20 in Figure 2B) reflections along the optical waveguide into electrical signals; and

removing noise (the combination of 32 and 34 in Figure 2B) produced by the noise producing element from the electrical signals such that the electrical signals from the optical filter element are retained (column 4 line 16-67).

Davis uses spectral analysis to analysis noise (32 and 34 in Figure 2B, and Figure 3 and 4); and removing noise includes performing a frequency analysis (34 in Figure 2B is the spectral analysis device). But Davis does not expressly disclose that (A) the noise reduction system includes performing a frequency analysis of the **periodic noise** and gate out the periodic noise produced by the noise producing element from the electrical signals; and (B) wherein gating out the periodic noise comprises removing a rapid varying signal from the frequency analysis (claim 27).

With regard to item (A), however, Cooper et al discloses a system in which the noise reduction system (20 in Figure 2 and 7) performs a frequency analysis (a standard optical spectrum analyzer, [0071]) of the received signals to identify and further removes the noise from the optical signals. Cooper et al uses the frequency analysis and gating method to obtain a specific frequency and remove unwanted other frequency (Figure 4A – Figure 4C, [0071]). Although Cooper et al does not expressly state that the other frequency (e.g. the peak just on the left side of the 1553.4 nm in Figure 4A, which is shown in Figure 4C) is a "periodic noise", that peak is indeed a

"noise" relative to the specific frequency component 1553.4 nm which is shown in Figure 4B; and since this "noise" is generated by another FBG, it is indeed a "periodic noise". Therefore, Cooper et al's system is fully capable to remove other periodic noise produced by connectors and splicers et al. And the wideband noise can be removed by gating the noise out of the electrical signals too (Figure 8, [0077]).

Cooper et al also discloses the noise reduction system performs a frequency analysis of the electrical signals and removes the periodic noise from the electrical signals by gating the periodic noise out of the electrical signals (Figure 13, page 8, [0091], "Each of these high-speed electrical pulses will now contain the wavelength information of their respective sensor grating 30A to 30N. These pulses are then passed to the electronic gating unit 142 where the pulses from the different sensors are isolated and measured for their wavelength information in a similar manner to the gating action performed on the optical signal in unit 20 except now performed electronically instead of optically. The signal from the reference detector is relayed to the electronic gating unit 142 through path 146 to serve as a timing reference").

However, to perform a frequency analysis, such as a Fourier analysis, on an electrical signal and gate out the periodic noise comprises removing a rapid varying signal from the frequency analysis (item B) is well known and widely used method in the art. Wang et al discloses a system and method that uses Fast Fourier Transform technique to analyze the periodic noise of an electrical signal and remove the periodic noise from the electrical signals (Abstract, Methods of Interference Eliminated); and the

gating out the periodic noise comprises removing a rapid varying signal from the frequency analysis (Figures 2 and 3, and Digital Filtering Technique).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the frequency analysis and noise gating as taught by Cooper et al and Wang et al to the system of Davis so that the noise can be efficiently identified and removed or gated out of the electrical signals, and measurement accuracy can be enhanced.

4. Claims 2, 7, 12 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davis et al (US 6,346,702) and Cooper et al (US 2002/0025097) and Wang et al (Wang et al: "Analysis and Suppression of Continuous Periodic Interference for On-Line PD Monitoring of Power Transformers", High Voltage Engineering Symposium, 22-27 August 1999, 5.212.P5) as applied to claims 1, 11 and 21 above, and in further view of Keown (US 4,143,350).

1). With regard to claims 2, 12 and 22, Davis et al and Cooper et al and Wang et al discloses all of the subject matter as applied to claims 1, 11 and 21 above. And Davis teaches that the "variable threshold peak detection unit 32 determines the DC component of the background signal by performing two running averages along the spectral trace. … . The local threshold value includes an overall minimum level term which is comparable to the noise level of the variable threshold peak detection unit 32". But Davis does not explicitly state wherein the noise reduction system or signal processor averages broadband noise and then subtracts the averaged level from the electrical signals.

However, the method of averaging the broadband noise and then subtracting the averaged level from the electrical signals is a well known method and widely used in the signal processing, such a method is used by Keown to remove the background noise (ABSTRACT and column 6, line 6-15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the method of averaging noise taught by Keown to the system of Davis et al and Cooper et al and Wang et al so that the broadband noise can be effectively suppressed and system performance is enhanced.

2). With regard to claim 7, Davis et al and Cooper et al and Wang et al discloses all of the subject matter as applied to claims 1, 4 and 5 above. And Davis teaches that the "variable threshold peak detection unit 32 determines the DC component of the background signal by performing two running averages along the spectral trace. … . The local threshold value includes an overall minimum level term which is comparable to the noise level of the variable threshold peak detection unit 32". But Davis does not explicitly state wherein the noise reduction system or signal processor averages broadband noise and then subtracts the averaged level from the electrical signals.

However, the method of averaging the broadband noise and then subtracting the averaged level from the electrical signals is a well know method and widely used in the signal processing, such a method is used by Keown to remove the background noise (ABSTRACT and column 6, line 6-15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the method of averaging noise taught by Keown

to the system of Davis et al and Cooper et al and Wang et al so that the broadband noise can be effectively suppressed and system performance is enhanced.

5. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davis et al (US 6,346,702) and Cooper et al (US 2002/0025097) and Wang et al (Wang et al: "Analysis and Suppression of Continuous Periodic Interference for On-Line PD Monitoring of Power Transformers", High Voltage Engineering Symposium, 22-27 August 1999, 5.212.P5) as applied to claim 11 above, and in further view of Kringlebotn (US 6,097,487).

Davis et al discloses all of the subject matter as applied to claim 11 above. And Davis et al discloses a broadband source. But Davis does not disclose that the source includes a tunable laser (claim 16); and the source includes a broadband light source and a tunable filter (claim 17).

However, Kringlebotn et al, in the same field endeavor, discloses a tunable laser or a broadband light source and a tunable filter (1 and 2 in Figure 1, Figure 4 and 6, column 2 line 62-67). By using a tunable filter, a fixed F-P filter, and a reference wavelength FBG, Kringlebotn et al constructs either a spectrum analyser with a high degree of wavelength accuracy, or a control system for a tunable laser or a multi-wavelength laser array to be able to control and set the wavelength of the tunable laser/wavelengths of the laser array with a high degree of repeatability and accuracy, typically <1 pm.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply a tunable laser or a broadband light source with a

tunable filter taught by Kringlebotn et al to the system of Davis et al so that an accurate frequency/wavelength scale can be obtained and system performance can be enhanced.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kersey et al (US 5,945,666) discloses a FBG sensor with optical spectrum analyzer.

Chen et al (US 2004/0046109) discloses a method of sampling FBG sensors and a signal threshold value is used to remove background noise.

Gardner (US 2004/0155794) discloses a FBG sensor and uses a adaptive filter and Fourier transform to remove periodic noise et al.

Chan et al (Chan et al: "Enhancement of Measurement Accuracy in Fiber Bragg Grating Sensors by Using Digital Signal Processing", CLEO 98, Technical Digest. Summaries of papers presented at the Conference on Lasers and Electro-Optics, 1998, 3-8 May 1998 Page 311 – 312).

Pieterse et al (US 20040245441) discloses a system and method for monitoring environmental effects using optical sensors with Fourier analysis.

Zverev et al ("Optical Method for Separation of Signals from a Periodic Noise Background", Radiophysics and Quantum Electronics, Springer NY, Vol. 25, No. 2, Feb 1982, pate 141-144) teaches a method to remove periodic noise by Fourier analysis.

Yadlowsky et al (US 2004/0052523) discloses a method and system for estimating the bit error rate in optical communication, and Fourier transform is used to frequency analysis.

Kantorovich (US 2004/0078156) discloses a method to filter out random noise by averaging measurements.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Li Liu whose telephone number is (571)270-1084. The examiner can normally be reached on Mon-Fri, 8:00 am - 5:30 pm, alternating Fri off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Vanderpuye can be reached on (571)272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Li Liu
March 12, 2007

KENNETH VANDERPUYE
SUPERVISORY PATENT EXAMINER